

REMARKS

Claims 12-40 are pending in the present application. In the Office Action dated June 14, 2006, claims 12-16, 20-23, 28, 30 and 37-39 were rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,877,844 to Matsumoto (“Matsumoto”). Claims 17, 24-27, 29, and 33-36 were rejected under 35 U.S.C. 103(a) as being unpatentable over Matsumoto in view of U.S. Patent No. 5,806,424 to Elliot (“Elliot”). Claims 18 and 19 were rejected under 35 U.S.C. 103(a) as being unpatentable over Matsumoto in view of U.S. Patent No. 6,359,662 to Walker (“Walker”). Claims 31 and 32 were rejected under 35 U.S.C. 103(a) as being unpatentable over Matsumoto in view of U.S. Patent No. 4,958,150 to Dabbaj (“Dabbaj”). Claim 40 was rejected under 35 U.S.C. 103(a) as being unpatentable over Matsumoto in view of U.S. Patent No. 5,699,145 to Makinouchi (“Makinouchi”).

The disclosed embodiments of the invention will now be discussed in comparison to the prior art. Of course, the discussion of the disclosed embodiments, and the discussion of the differences between the disclosed embodiments and the prior art subject matter, do not define the scope or interpretation of any of the claims. Instead, such discussed differences merely help the Examiner appreciate important claim distinctions discussed thereafter.

The disclosed embodiments of the present invention are directed to an apparatus for masking display element defects in a display device. In one embodiment, a display device includes an array of display elements disposed on a display surface, wherein at least one of the display elements is at least partially defective. A signal source provides a signal to each of the display elements so that a visual image is formed on the display surface. A translation unit connected to the display surface imparts motion to the display surface such that the display surface may be moved horizontally, vertically or a combination of horizontal and vertical directions. A control unit included in the display device controls the translation unit and signal source to move the display surface while controlling the signal source to correspondingly shift the image signals. Thus, when the image signals are shifted and displayed, the defective display elements are concealed while presenting a stable image to a stationary viewer.

The invention will now be summarized with reference to Figures 2 and 3 of the application. A display region 11 is shown in Figure 2 with adjoining display elements 20-31 that correspond to physical areas on a display surface 10. The display elements 20-31 on the region

11 are arranged in rows 35-37 and columns 38-41. Image elements P₂₀-P₃₁ are respectively associated with the display elements 20-31, and each image element P₂₀-P₃₁ is individually projected onto the region 11 by image signals V₂₀-V₃₁, thereby creating an image, or portion of an image, that may be seen visually. A single display element 25, located in the region 11, is at least partially unresponsive to the applied input signal V₂₅, while the display elements 20-23, 24, 26, 27 and 28-31 are fully responsive and function normally to the image signals V₂₀-V₂₃, V₂₄, V₂₆, V₂₇ and V₂₈-V₃₁ respectively. Due to the defect in the display element 25, the image element P₂₅ associated with the image signal V₂₅ does not fully appear in the display element 25.

Referring now to Figure 3, the display elements 20-31 are shown after the region 11 has been physically translated a distance of one column width to the left to mask the defective display element 25. While the signal display element 25 is at least partially unresponsive to the applied image signal V₂₅, all other display elements 20-24 and 26-31 are fully responsive to the image signals V₂₀₋₂₄ and V₂₆₋₃₁, and therefore function normally. In response to the physical translation of the region 11 to the left, the image elements P₂₀-P₃₁ are simultaneously translated a corresponding distance of one column width to the right by redirecting all the image signals V₂₀-V₃₁ one column width to the right. As a result, the information previously associated with the input signal V₂₅ that could not be fully viewed in the defective display element 25, is now viewed in display element 26. Similarly, all other functioning display elements 20-31 receive a corresponding image signal V₂₀₋₃₁ that has now shifted one column width to the right to redirect all image elements P₂₀-P₃₁ one column width to the right when displayed. After all image elements P₂₀-P₃₁ have been displayed by the redirected image signals V₂₀-V₃₁, the region 11 is physically translated back one column width to the right so that the image elements P₂₀-P₃₁ are projected onto respective display elements 20-31 as initially positioned and shown in Figure 2, whereupon the image is displayed again. The image signals are not varied in magnitude as the image signals V₂₀₋₃₁ are redirected. By maintaining a generally constant image signal level, the display image appears as a stable image having a uniform illumination level, despite the fact the display is moved. Accordingly, the displayed image is generally indistinguishable from an image that would be viewed by an individual who was viewing the same image on a stationary display device that did not have any defects.

The primary reference cited in the Office Action is the patent to Matsumoto, which describes an image exposure method that uses a liquid crystal display (LCD) device. With reference to Figure 1, an LCD 20 is placed between a light source 14 and a photosensitive material 38, wherein light is projected through the LCD 20 to expose the photosensitive material 38 so that an image is formed thereon. The Matsumoto patent describes a method for correcting defective pixels in the LCD 20 by changing the position and amount of exposure on the defective pixel over multiple exposures of the image. Multiple exposures are processed by displacing the defective pixel as many times as needed to obtain the plurality of images so that no single image depends upon the defective pixel completely, and the "defect" can be disbursed to a plurality of images (Col. 2, line 41 to Col. 3, line 4). Since a photosensitive material is exposed, the amount of exposure (amount of light signal) to all peripheral pixels must also be adjusted with each displacement of the defective pixel in order to avoid overexposure. Figure 4 shows a plurality of peripheral pixels (display elements) whose exposure amounts must be recalculated to factor in the total number of exposures necessary to correct the defective pixel at D6. For example, in Figure 4, the defective pixel is first exposed at position D6 and exposed a second time after a displacement to E6, where the exposure amount (light signal) applied to D6 during the first exposure is different than the exposure amount applied to E6 during the second exposure (Col. 8, lines 11-41). The peripheral pixels C6, D5, D7, E5, E7 and F6 are corrected in accordance with the desired number of exposures at D6 and then at E6, otherwise the peripheral pixels cannot be exposed again if they are exposed by the full amount during the first exposure effected. Figures 5A-5B and 6A-6B show in detail a correction procedure and corresponding algorithms for recalculating the signal level of each of the pixels in the defective region.

The Matsumoto reference fails to disclose an apparatus whereby applied image signal levels are maintained at a fixed level as the applied signals are shifted to an adjacent display element. In fact, the LCD device of the Matsumoto patent cannot apply a fixed signal level to all of the display elements in the region since it would result in overexposing the photosensitive material. Instead, the Matsumoto patent describes in detail methods for recalculating different exposure amounts for each pixel in the defective region each time an exposure is effected (Col. 8, line 11 to Col. 10, line 18). The image signal levels are therefore not maintained at a fixed level, and in fact cannot be maintained at a fixed level when using the

method described by the Matsumoto patent. Accordingly, the Matsumoto patent is distinguishable from the Applicant's disclosure, and does not describe masking a defective display element by maintaining image signal levels at a fixed level as they are shifted to generate an image on the display device that appears indistinguishable from an image that appears not to have any defects to a stationary viewer.

Turning now to the claims, amended claim 12 is directed towards a device for masking defects in a visual display having a visual display unit, a translation unit, a display signal source and a control unit. When a defect occurs in a display element of the visual display, the control unit exchanges signals between the translation unit and the display signal source to impart motion on the display unit and "compensatingly shift the input signals to the display elements on the surface of the visual display, the input signals to the display elements *being maintained at a fixed signal level as they are shifted*," to conceal the display element defect on the display surface when displayed. (Emphasis added). As explained above, the Matsumoto patent does not teach display elements that are maintained at a fixed signal level as they are shifted. The Matsumoto patent teaches the opposite, where the amount of light signal exposed to the display elements (pixels) in the defective region is individually calculated, and where the amount of light exposed varies depending on the calculation to avoid overexposure. Claim 12 is therefore not anticipated by the Matsumoto patent.

Amended claim 23 is directed towards a device for masking defects in a visual display surface and recites, in part, a control unit that controls a signal source unit and a translation unit to shift a display surface in a predetermined direction and to correspondingly shift the image signals to compensate for the display device shift. The image signals are "*maintained at a fixed signal level as the image signals are being shifted*" to obtain a stable image that conceals a defective display element. (Emphasis added). As described previously, the Matsumoto patent does not teach maintaining signals at a fixed signal level when masking defects in display surfaces. Instead, the Matsumoto patent teaches varying the image signal levels to prevent overexposure of the display elements as previously explained, and further describes a method for reducing the effect of the defective element instead of concealing the defect. Accordingly, claim 23 is also not anticipated by the Matsumoto patent.

The remaining claims in the application are patentably distinguished over the cited references because of their dependency on patentable independent claims and because of additional limitations added by those claims. Although many of these claims have been rejected on the basis of the patent to Matsumoto in combination with other references, none of these other references disclose the subject matter that is missing from the Matsumoto patent.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,
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Enclosures:

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